

What is claimed is:

1. A plasticating apparatus comprising:

a barrel having an inlet and an outlet;

5 a rotatable screw disposed within and cooperating with  
an inner wall of said barrel, said screw adapted for  
plasticating resinous material fed into said barrel through  
said inlet, said screw comprising;

10 a longitudinal axis with a feed section, a barrier  
melting section and a metering section disposed sequentially  
downstream along said screw axis, a reorientation section is  
disposed between the barrier melting section and the metering  
section;

15 said screw including a main helical flight having a push  
side and a trailing side, said main flight forming a feed  
channel at said inlet of said screw;

20 a barrier flight disposed in said barrier melting  
section intermediate said main flight, said main flight  
having a constant pitch in the barrier melting section, said  
barrier flight and said main flight dividing said barrier  
melting section into a melt channel and a solids channel  
extending helically side by side, said barrier flight having  
helical threads with a diameter less than the diameter of

helical threads of said main flight, so that melt material flows over said barrier flight and into said melt channel, whereby solid material conveyed along said barrier melting section is positioned adjacent said trailing side and whereas melt material conveyed along said barrier melting section is positioned adjacent said push side;

said barrier flight discontinuing at a terminal end of said barrier melting section;

said main helical flight passing into the reorientation section makes a rotation of at least 540° about said screw axis at a pitch less than the pitch of the main flight in the barrier melting section, said melt channel and said solids channel in said barrier melting section merging into a substantially uniform reorientation channel in said reorientation section thereby forcing solid plastic material conveyed along said reorientation section toward said push side of the main flight; and

a secondary flight disposed in said metering section intermediate said main flight, and said main flight continuing into said metering section from the reorientation section, whereby solid material conveyed along said metering section is positioned primarily adjacent said push side of

the main flight and whereas melt material conveyed along said metering section is positioned primarily adjacent said trailing side of the main flight.

5           2.    The apparatus of claim 1, wherein said main flight has a substantially constant diameter throughout said metering section and said barrier flight has a substantially constant diameter throughout said barrier melting section.

10           3.    The apparatus of claim 1, wherein said main flight has a thread width greater than said secondary flight in said metering section.

15           4.    The apparatus of claim 1, wherein said barrier flight has a diameter substantially the same as said secondary flight.

20           5.    The apparatus of claim 4, wherein said barrier flight has a width substantially the same as said secondary flight.

          6.    The apparatus of claim 5, wherein said metering

section is a multi-channel undulating metering section.

7. A plasticating apparatus comprising:

a barrel having an inlet and an outlet;

5 a rotatable screw having a longitudinal axis, the screw being disposed within and cooperating with an inner wall of said barrel, said screw adapted for plasticating resinous material fed into said barrel through said inlet, said screw comprising;

10 a feed section, a barrier melting section, a reorientation section and a multi-channel undulating metering section located sequentially downstream along said screw axis;

15 said screw including a main helical flight having a push side and a trailing side, said main flight forming a feed channel at said inlet of said screw at the feed section;

20 a barrier flight disposed in said barrier melting section intermediate said main flight, said barrier flight and said main flight dividing said barrier melting section into a melt channel and a solids channel extending helically side by side, said barrier flight having helical threads with a diameter less than the diameter of helical threads of said

main flight so that melt material flows over said barrier  
flight and into said melt channel, whereby solid material  
conveyed along said barrier melting section is positioned  
adjacent said trailing side of said main flight and whereas  
5 melt material conveyed along said barrier melting section is  
positioned adjacent said push side of said main flight;

said barrier flight terminating at a terminal end of  
said barrier melting section;

10 said main helical flight traversing through the  
reorientation section having a rotation at least 360° about  
the longitudinal axis of said screw, said main flight  
including a decreased pitch beginning substantially adjacent  
to the terminal end of said barrier melting section and  
resuming said decreased pitch through said reorientation  
15 section, said solids channel and said melt channel merge into  
a substantially uniform reorientation channel at a location  
substantially coinciding with said decreased pitch of said  
main flight thereby forcing solid plastic material conveyed  
along said reorientation section toward said push side of the  
20 main flight; and

said main flight passing into said metering section, a  
secondary flight being disposed in said metering section

intermediate said main flight whereby solid material conveyed  
along said metering section is positioned primarily adjacent  
said push side of the main flight and whereas melt material  
conveyed along said metering section is positioned primarily  
adjacent said trailing side of the main flight.

8. The apparatus of claim 7, wherein said solids  
channel and said melt channel maintain substantially constant  
widths through said barrier melting section, said solids  
channel narrows at a position along said screw coinciding  
with said decreased pitch of the main flight.

9. The apparatus of claim 7, wherein the main helical  
flight passing into the reorientation section makes a  
rotation of at least  $720^\circ$  about said screw axis.

10. The apparatus of claim 7, wherein the main helical  
flight passing into the reorientation section makes a  
rotation at least  $1440^\circ$  about said screw axis.

11. The apparatus of claim 7, wherein the main helical  
flight of the reorientation section having a helix angle  $\theta$  of

approximately 19.5°.

12. The apparatus of claim 11, wherein the helix angle  $\theta$  of the main helical flight of the reorientation section and the melting section are substantially equal.

13. A plasticating apparatus comprising:  
a barrel having an inlet and an outlet;

a rotatable screw having a longitudinal axis, the screw being disposed within and cooperating with an inner wall of said barrel, said screw adapted for plasticating resinous material fed into said barrel through said inlet, said screw comprising;

a feed section, a barrier melting section, a reorientation section and a multi-channel undulating metering section located sequentially downstream along said screw axis;

said screw including a main helical flight having a push side and a trailing side, said main flight forming a feed channel at said inlet of said screw at the feed section;

a barrier flight disposed in said barrier melting section intermediate said main flight, said barrier flight

and said main flight dividing said barrier melting section into a melt channel and a solids channel extending helically side by side, said barrier flight having helical threads with a diameter less than the diameter of helical threads of said main flight so that melt material flows over said barrier flight and into said melt channel, whereby solid material conveyed along said barrier melting section is positioned adjacent said trailing side of said main flight and whereas melt material conveyed along said barrier melting section is positioned adjacent said push side of said main flight;

said barrier flight terminating at a terminal end of said barrier melting section;

said main helical flight traversing through the reorientation section having a rotation at least  $540^\circ$  about the longitudinal axis of said screw, said main flight including a decreased pitch beginning substantially adjacent to the terminal end of said barrier melting section and resuming said decreased pitch through said reorientation section wherein the main flight has a helix angle  $\theta$  between  $15^\circ$  and  $21^\circ$ , said solids channel and said melt channel merge into a substantially uniform reorientation channel at a location substantially coinciding with said decreased pitch



of said main flight thereby forcing solid plastic material conveyed along said reorientation section toward said push side of the main flight; and

5        said main flight passing into said metering section, a secondary flight being disposed in said metering section intermediate said main flight whereby solid material conveyed along said metering section is positioned primarily adjacent said push side of the main flight and whereas melt material conveyed along said metering section is positioned primarily adjacent said trailing side of the main flight.

10        14. The apparatus of claim 13, wherein the helix angle  $\theta$  of the main helical flight of the reorientation section and the melting section are substantially equal.

15        15. The apparatus of claim 14, wherein said barrier flight has a diameter substantially the same as said secondary flight.

20        16. The apparatus of claim 15, wherein said barrier flight has a width substantially the same as said secondary flight.